Appendix 6 - Soils Modules Purpose, Assumptions, and Methodology

Soil Productivity Assessment Module

Purpose/Key Questions - This assessment will identify the areas with similar soils and natural, inherent, productivity. The following Key Question will be addressed by this assessment:

WS6 What is the inherent, natural range of soils/site productivity and has it been affected by man?

Assumptions

Soils with similar properties and characteristics have similar inherent productivities/resiliency and behave similarly.

- Data from SCS soil surveys combined with professional knowledge/experience of soil characteristics and behavior can be used to develop mapping units that identify soil capability/resiliency.
- Soil characteristics, including moisture and temperature regimes, have some correlation to vegetative communities.

Methodology - Resiliency Units for Wolf Creek watershed have been created by combining map units listed by SCS in the *Soil Survey of Lane County Area, Oregon*. Each Resiliency Unit has soils with similar properties/characteristics. Resiliency units are based on such factors as soil temperature and moisture regimes, and soil drainage, depth, coarse fragment content, texture, water holding capacity, nutrient capital, permeability, etc.

A high resilient unit can sustain substantial manipulation and still maintain nutrient capital, inherent physical and chemical capabilities, hydrologic function, and natural rates of erosion.

A low resilient unit requires, for the most part, protection and offers minimal opportunities for manipulating the surface vegetation without impairing inherent properties and processes, and/or accelerating the frequency and magnitude of erosional events.

Eleven resiliency units were created to cover the Eugene District. These units cover xeric and udic temperature regimes, mesic and cryic temperature regimes, and wetland type soils.

Mass Movement Assessment Module

Purpose/Key Questions - This assessment will identify the potentially unstable mass movement areas in the Wolf Creek watershed. The following Key Questions will be addressed by this assessment:

WS1 Where is there evidence of, or potential for, mass wasting in the watershed?
WS2 What mass wasting processes are active?
WS3 Where do erosion processes (mass wasting) deliver sediment to stream channels or other waters?

Assumptions

- Identification of existing mass movement features can be used to predict the likelihood of future instability. Areas prone to these processes can be mapped based on physical characteristics, as interpreted from aerial photographs, topographic maps, and geologic and soils maps.

< Results from research, inventories, and models can be used to help predict the likelihood of future instability.

< It is feasible to extrapolate from one sub-basin to another having similar characteristics.

Methodology - A mass movement potential map (Map -2) was constructed using GIS with topography (slope steepness), stream location, and Timber Productivity Capability Classification (TPCC) (field identified unstable areas) themes. Three categories of relative potential for mass movement were mapped using the following criteria:

High
- Mass movement features are common and/or there is significant potential for mass wasting.
- Mapped FGNW in TPCC
- Stream adjacent (within 100 ft. of streams) sideslopes > 75%
- Steep (> 75%) and convergent slopes

Moderate
- Mass movement features and potential for mass wasting are intermediate and do not fit into the High or Low categories.
- Stream adjacent sideslopes with 55-75% slopes
- Slopes > 100 ft. from streams with slopes > 65%
- Moderate (55-75%) and convergent slopes
- Mapped FPR areas in TPCC
- Areas with pyroclastic or breccia bedrock and/or areas of bedrock discontinuities that have hummocky topography indicative of mass movement features.

Low
- Mass movement features are few to nonexistent and factors contributing to slope instability are practically absent.
- Stream adjacent sideslopes < 55%
- Planar slopes > 100 ft. from streams < 65%
- Convergent slopes < 55%.

Data from studies from the USFS Mapleton Ranger District[1] can apply to the western half of Wolf Creek watershed. These data, which addressed types of mass failures and where they most often occurred, and field experience of BLM soil scientists were used to indicate the types of mass failures active in Wolf Creek watershed and to indicate where on the topography failures are occurring. The results of these data and field experience of BLM and USFS soil scientists, hydrologists, and geomorphologists were used in the construction of these categories for mass movement potential shown on Map 2.

Past experience (1980-82) by BLM soil scientists and by Ketcheson and Froehlich on the USFS Mapleton Ranger District indicated that aerial photo inventories of shallow, translational failures do not identify some of the small and moderate sized failures under the canopies of older forests. Aerial photo inventories, as advocated by some, are not accurate in the Coast Range as a way of tracking landslide frequencies, volumes, etc. Such inventories need to occur after a catastrophic storm year under management regimes and road conditions similar to the current situation. Even under these circumstances, events underneath the Coast Range forest canopy, especially those of smaller magnitude, would be greatly undercounted. Recognizing this, two sets of aerial photos (1953 and 1990) were reviewed to determine the types of mass wasting that are, or were, active in the watershed.

After abandoning a futile attempt at utilizing helicopter mapping of landslides, the Eugene District BLM stepped up to the task of mapping these features with on-the-ground, inventories of high-risk areas within the Eugene District's Coast Range Resource Area. Much of this effort was contracted out to geologists and research hydrologists with special expertise and experience in the mapping of these features in Coast Range terrain. Contract data requirements and methods were developed under the guidance of research scientists from the USFS Intermountain Research Station at Moscow, Idaho as part of an ongoing research and development effort focused on modeling slope stability. This data and these past efforts have led to a current effort with Dr. William E. Dietrich of U.C. Berkeley to analyze the Coast Range terrain utilizing GIS and digital terrain modeling in conjunction with the current field data for ground truthing. This effort will serve the Watershed Analysis process in 1995, but is not currently available for Wolf Creek. However, most high-risk sites on BLM administered land in the Wolf Creek watershed have been analyzed on-the-ground (by contractor individual project investigation) and the results have been entered into the TPCC (Timber Production Capability Classification system) as FGNW (fragile, nonsuitable woodland) and are included in the "High" mass wasting category (Map 2). These slope stability inventories included mapping of old landslide scars; intensive description of each headwall with several cross sections of soil depth, slope angles, and included recording of site indicators (tension cracks, pistolbutted trees, seeps, slumps) that might indicate failure potential. These areas reflecting features of instability are withdrawn from any timber management and will be left to function at natural rates and magnitudes as sources of debris for downstream resources.

<u>Hillslope Surface Erosion Assessment Module</u>

<u>Purpose/Key Questions</u> - The purpose of this assessment is to identify the existing and potential hillslope related surface erosion areas that contribute sediment to stream channels. The following Key Questions are addressed by this assessment:

WS3 Where do erosion processes (hillslope) deliver sediment to stream channels or other waters?

WS4 What is the hillslope erosion potential (eg., what areas are sensitive)?

<u>Assumptions</u>

< Sheet erosion of hillslopes is influenced primarily by soil type, hillslope gradient, protective cover, precipitation intensity, and human activity

< Certain soils (easily detachable) and slope conditions (steeper) are conducive to surface erosion.

< On potentially erodible soils, the primary factors determining whether surface erosion occurs are exposure and compaction of mineral soil and topography. Surface erosion tends to increase as these 3 characteristics increase.

< Certain management practices can expose and/or compact surface mineral soil and significantly increase surface erosion. Activities/practices that do not expose or disrupt the surface mineral soil are unlikely to increase surface erosion.

< Surface erosion may be delivered anywhere in the stream system by dry ravel or overland flow, but is fairly easily disrupted by buffer of slash, duff, and other protective soil cover. Therefore, sediment is generally not delivered to the stream system if adequate buffers exist on the hillslopes.

< Dry ravel is primarily a function of slope gradient, hillslope storage potential, surface cover, and soil erodibility.

< Most surface erosion occurs within 5 years of a contributing activity.

<u>Methodology</u> - A Hillslope erosion risk class map (Map 4) was constructed using GIS with topography (slope steepness) and soils (USDA Soil Conservation Service, K factors) themes. Three categories of relative potential for erosion of exposed mineral soil were mapped using the following criteria:

<u>High</u>	Slopes > 65%, K > .25
	Slopes > 30%, K > .40
<u>Moderate</u>	Slopes > 65%, K < .25
	Slopes 30-65%, K .25-.40
	Slopes < 30%, K > .40
<u>Low</u>	Slopes < 30%, K .25-.40
	Slopes < 65%, K < .25

From past experience, it was decided that the use of aerial photographs would not be helpful in determining sites with existing surface erosion (e.g., gullies). Field visits were conducted for the 3 erosion potential categories to determine presence (and degree) or absence of erosion.

<u>Road Related Erosion/Sediment Assessment Module</u>

<u>Purpose/Key Questions</u> - The purpose of this assessment is to identify the existing and potential road related sediment producing areas that contribute to stream channels in the 37,892 acre Wolf Creek watershed. This assessment will address the following Key Questions:

WS3 Where do erosion processes (roads) deliver sediment to stream channels or other waters?

WS5 What is the sediment potential from roads?

<u>Assumptions</u>

< Surface erosion occurs from nearly all roads. However, excluding problem sites, sediment delivery to channels can occur when ditches or culverts drain directly into channels (includes gullies connected to or when ditches or culverts drain within 200 feet of the channel. Within this zone, the sediment delivery ratio is 100%.[2]

< During wet weather, heavily trafficked roads produce substantially more sediment than during

dry weather or low traffic.[3] [4]

- Most road construction sediment is produced within the first 3 years of life of the road, but may continue at a reduced rate for longer periods.[5]

- Ridge top roads not draining to defined channels are considered to be non-contributing unless field evidence suggests otherwise.

- Reclaimed roads have full recovery of infiltration and erosion potential unless field evidence suggests otherwise.

<u>Methodology</u> - Road locations, miles of road, and road surface types were determined by GIS and associated attribute files. To give some idea of location of the road system on the topography, GIS was used to categorize the roads into one of 3 categories:

- Ridge top (within 75 feet of ridge tops);

- Lower slope (within 200 feet of 3rd Order and larger streams); and

- Midslope (not ridge top or lower slope).

A field inventory of most, if not all, roads in the Wolf Creek drainage was conducted in July and August by Bureau of Land Management Soil Scientists to determine:

1. Which segments have the opportunity to deliver sediment to a channel.

2. Which segments have contributing cutbanks or fillslopes.

3. Type of surfacing and traffic levels on segments with the potential to deliver sediment.

Notes were taken to record the above information by road segment. Per the assumptions and procedures in the Washington State Watershed Analysis Manual, a road was considered to lack the potential to deliver sediment if stream crossings were absent (ridge tops and spur ridges) and the nearest channel was 200 feet or more away from the road.

The procedures for assessing road related sediment contributed to stream channels outlined in the Washington State Watershed Analysis Manual (pp. B 18-31) were used to analyze roads in the Wolf Creek watershed. These procedures consider type of parent material, surfacing, traffic rates, ground cover density of cuts and fills, annual precipitation, and drainage location/proximity to stream channel to predict sediment delivered to channels.

1. Ketcheson, G. and H.A. Froehlich. 1972. Landslide Inventory - Mapleton Ranger District, Oregon. USDA Forest Service, Siuslaw National Forest, Corvallis, OR.

2. Burroughs, E.R. and J.G. King. 1989. Reduction of Soil Erosion on Forest Roads. USDA Forest Service, Intermountain Research Station, Gen. Tech. Rep. INT-264, 21p.

3. Reid, L.M. and T. Dunne. 1984. Sediment Production From Forest Road Surfaces. Water Resources Research 20(11): 1753-1761.

4. Sullivan, K.O. and S.H. Duncan. 1980. Sediment Yield From Road Surfaces in Response to Truck Traffic and Rainfall. Weyerhaeuser Company, Tacoma, WA, Technical Report 042-4402/80.

5. Megahan, W.F. 1974. Erosion Over Time on Severely Disturbed Granitic Soils: A Model. USDA Forest Service. Research Paper INT-156.